



success stories

PROJECTS THAT REDUCE POLLUTION AND WASTEWATER

Highlights:

LSI Logic wanted to have the ability to expand their manufacturing facility, but was limited by the amount of water supply that was available.



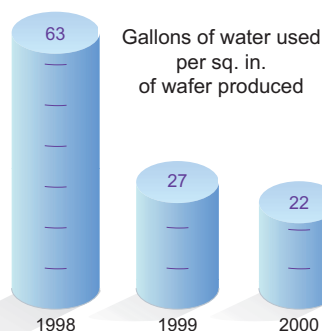
Project: Idle flow reduction on chemical/mechanical polishing equipment

Equipment & installation costs: \$7,000 for design, testing and programming

Project challenges: None. Product yield rates were unaffected by the water reduction

Payback: Six months

Water savings: 9,000 gallons per day (16% of CMP flow)



LSI Logic determined that some of the tools use water at a constant rate whether any product is in process or not. They reduced wastewater by decreasing the water flow during idle times.

LSI Logic uses logic to find water reduction

LSI LOGIC is a manufacturer of custom integrated circuits with local facilities in Milpitas and Santa Clara. Local manufacturing is done in Santa Clara. With a water supply restricted by the size of their incoming line and requirements from the San Jose/ Santa Clara Water Pollution Control Plant (Plant) to investigate potential water conservation, LSI Logic evaluated their manufacturing areas to see what opportunities for wastewater reduction were available. LSI Logic determined that some of the tools they use to manufacture integrated circuits use water at a constant rate whether any product is in process in that tool or not. They decided to evaluate if the tool settings could be modified to reduce the amount of water used during idle time, when the equipment is on but no wafers are being processed. The tools evaluated are used for chemical/mechanical polishing (CMP) operations.

Problem: LSI Logic wanted to have the ability to expand their manufacturing facility (fab) but was limited by the amount of water supply that was available. Replacing the incoming line from the City of Santa Clara water utility was prohibitively expensive. LSI Logic was also required to complete a Flow Audit Study as a condition of their Industrial Wastewater Discharge Permit from the Plant, since their discharge was above 100,000 gallons per day (gpd). Their overall wastewater discharge was just over 200,000 gpd. They were also looking for ways to reduce operational costs. Six chemical/mechanical polishers, several in research and development and several in production, were identified for potential water savings. The six CMP machines were made by three different manufacturers and had different operating requirements, so each one was evaluated separately. The goal was to reduce the nearly 56,000 gpd overall water use from the CMP machines by 15%.

CMP is used during semiconductor manufacturing to smooth out multiple layers of metal and silicon on wafers prior to the next process step. The polishing is done with tools that dispense a slurry and ultra pure water onto orbiting circular pads that polish the wafers' surface. Each polishing tool uses menu-driven programs for each processing cycle. The programs use specified parameters (water flow, polishing speed, etc.) given by the manufacturer or identified through internal research. During idle times, when no wafers are being processed, ultra pure water is dispensed onto the platen and polishing pads to keep the humidity within the machine and the moisture on the platen and pads at a constant level. This helps to keep the polishing operation consistent. It was suggested that water flow during idle time could be lowered without affecting the humidity in the CMPs or the moisture content of the platens and polishing pads. The original manufacturers of the equipment may not have emphasized water efficiency in their design. The CMP tools used between 2 and 5 gallons per minute of water each during idle time prior to the investigation.

LSI met their water reduction goal, saved approximately \$15,000 per year in operating costs, and increased the amount of water available to expand their facility.

Solution: The Process Engineering Department, with assistance from the Environmental Department, put together a test procedure to determine the feasibility of reducing the idle flow rate through the CMPs. Dummy wafers (disposable test wafers) were processed on each of the CMP tools and the wafers were then inspected for polishing irregularities as the influent flow was reduced between polishing steps. The humidity in the process chambers was also monitored with chart recorders during the process. The water was reduced until appreciable defects in the test wafers were observed. A set point was then selected for idle water flow rate for each tool that had proven to be adequate to ensure satisfactory product quality. Production wafers were then run on the CMP tools with close monitoring of the process for unexpected defects. Between 150 and 200 hours of labor were expended on the design and testing of the CMP operations to determine the optimum set points. The humidity meters used for the testing were the only equipment costs spent for the study. Some work was required to do the final reprogramming of the CMPs with the new system parameters and to rewrite some specifications.

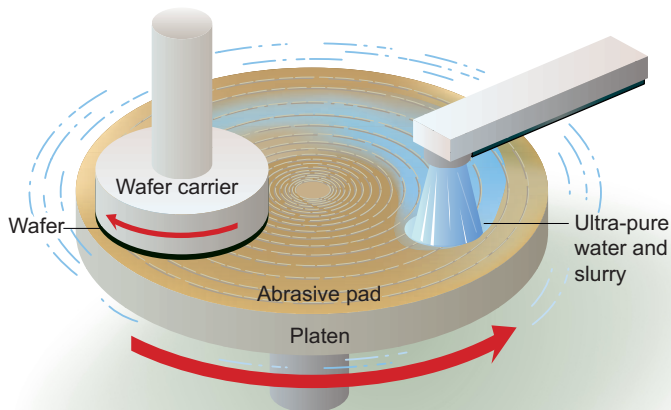
Results: LSI Logic reduced the discharge of wastewater from the CMP operation by over 9000 gallons per day while spending about \$7000 dollars. Most of the cost was for the labor required for the testing to determine the proper set points for the equipment. They met their goal of 15% water reduction (16% actual savings) and saved approximately \$15,000 per year in operating costs. The project paid for itself in about six months. LSI Logic had increased the amount of water available for other parts of the fab to expand. From 1998 to 2000, LSI was also able to increase efficiency in other areas of the fab enough to reduce the total gallons of water used to produce a square inch of wafer by 63% (see graph on Page 1). The large amount of testing performed prior to processing production wafers through the CMP machines resulted in no increase in defects over previously measured levels.

Challenges: There were no unexpected problems encountered during the investigation of this project. Approximately one shift of production was lost to the testing and reprogramming required in order to implement the flow rate changes. The most time consuming part of the investigation was changing the water feed rates on each CMP and then running dummy wafers through the process in order to test for defects produced by the reduction of water use.

Summary: The idle flow reduction of the CMP equipment saved LSI Logic over 9000 gallons per day of water, allowing them to expand other parts of their fab. The project paid for itself in about six months. Extensive testing of the changes using dummy wafers let LSI Logic process production wafers using the modified equipment with confidence that the quality would not be adversely affected. The expected high quality was verified through close monitoring of the early production runs. The entire project went smoothly from design to implementation, with only a minor production equipment interruption.

Thanks to Todd Geringer, Environmental Engineer at LSI Logic, for his assistance in preparing this case study.

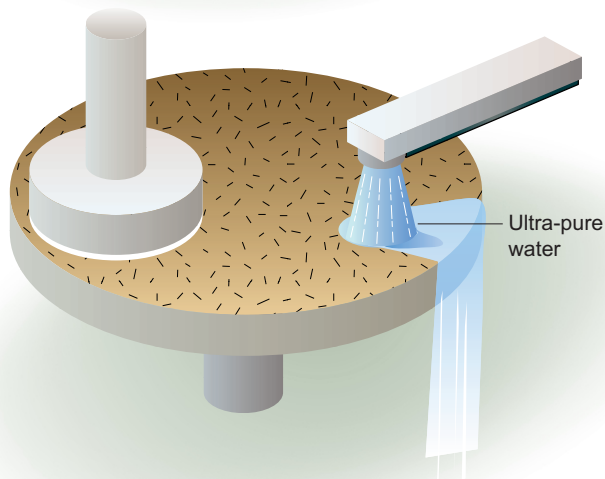
POLISHING PROCESS



Chemical/mechanical polishing (CMP) is used during semiconductor manufacturing to smooth out multiple layers of metal and silicon on wafers. The polishing is done with tools that dispense a slurry and ultra-pure water onto orbiting circular pads that polish the wafers' surface.

The entire project went smoothly from design to implementation, with only a minor production equipment interruption.

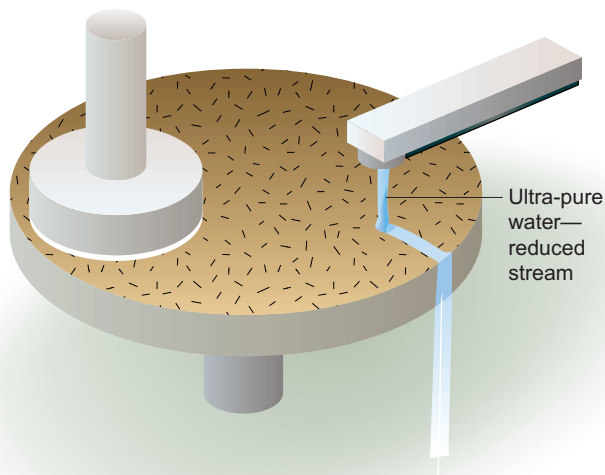
IDLE TIME: BEFORE WASTEWATER REDUCTION



During idle times, when no wafers are being processed, ultra-pure water is dispensed onto the platen and polishing pads to keep the moisture on the platen and pads at a constant level.

The CMP tools used between 2 and 5 gallons per minute of water during idle time.

IDLE TIME: AFTER WASTEWATER REDUCTION



Extensive testing established a set point for a reduced idle water flow rate proven to ensure product quality. LSI Logic reduced the discharge of wastewater from the CMP operation by over 9,000 gallons per day.



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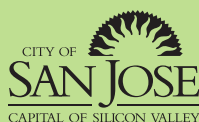
The San Jose / Santa Clara Water Pollution

Control Plant discharges treated wastewater into South San Francisco Bay. This area of the Bay is shallow, with a limited amount of tidal and tributary flushing. This creates unique challenges for the Plant in protecting the health of the South Bay. The Plant has been ordered by the Regional Water Quality Control Board to reduce its dry weather effluent flow, as well as the amount of copper and nickel discharged, in order to preserve endangered species' habitat and to meet state and federal water quality objectives.

To comply with these and other regulatory requirements, the City of San José has implemented a variety of programs improving water quality in the South Bay. These success stories demonstrate ways local companies have been able to reduce wastewater discharge or pollutants from their facilities.

San José offers financial incentives and other programs to encourage the implementation of such projects, including Water Efficient Technologies (WET). The WET program offers rebates of up to \$50,000 for reductions in wastewater discharge. Participants must apply before beginning a project, and they must document the amount of wastewater reduced as a result of the project.

For more information on WET or project success stories, call (408) 945-3700 or go to www.slowtheflow.com.



SAN JOSE/SANTA CLARA
WATER POLLUTION
CONTROL PLANT

In accordance with the Americans with Disabilities Act, City of San José Environmental Services Department materials can be made available upon request in alternative formats, such as large print, audio tape or computer disk. Requests may be made by calling (408) 277-5533 (V) or (800) 735-2929 (CRS).